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1 INTRODUCTION

This document describes the EMI qualification tests carried out at SERMS Laboratory, Università degli Studi di Perugia, Facoltà di Ingegneria, Sede di Terni, from 14th to 16th/09/2005.
The tests were performed on the part of the electronics contained inside the composite structure of the camera of AMICA. The electronics comprises the complete camera front end, such as the CCD, its control and the communication through a DSL line to the main processor.

Reference documents: SSP30237C (Space Station electromagnetic emission and susceptibility requirements).

The following tests were carried out:

1) CE01: Conducted Emissions, DC and AC Power Leads, 30 Hz ÷ 15 kHz:
   - part 1: 30 Hz ÷ 10 kHz.
   - part 2: 10 kHz ÷ 15 kHz.
2) CE03: Conducted Emissions, DC and AC Power Leads, 15 kHz ÷ 50 MHz.
3) CS01: Conducted Susceptibility, AC Power Leads, 30 Hz ÷ 50 kHz.
4) CS02: Conducted Susceptibility, AC Power Leads, 50 kHz ÷ 400 MHz.
5) CS06: Conducted Susceptibility, DC Power Leads, Spikes.
6) RE02: Radiated Emissions, Electric Field, 14 kHz ÷ 10 GHz:
   - part 1: 14 kHz ÷ 30 MHz.
   - part 2: 30 MHz ÷ 700 MHz.
   - part 3: 700 MHz ÷ 1 GHz.
   - part 4: 1 GHz ÷ 10 GHz.
   - part 5: 13.5 GHz ÷ 15.5 GHz.
7) RS03: Radiated Susceptibility, Electric Field, 10 kHz ÷ 18 GHz:
   - part 1: 10 kHz ÷ 100 kHz.
   - part 2: 100 kHz ÷ 30 MHz.
   - part 3: 30 MHz ÷ 700 MHz.
   - part 4: 700 MHz ÷1 GHz.
   - part 5: 1 GHz ÷10 G

The final result of the tests may be summarized on the following table:

TEST	**RISULTS**
1) CONDUCTED EMISSIONS: 60 Hz ÷ 15 KHz (CE01):	< limits
2) CONDUCTED EMISSIONS: 15 KHz ÷ 50 MHz (CE03):	< limits with some *
3) CONDUCTED SUSCEPTIBILITY: 30 Hz ÷ 50 KHz (CS01):	no malfunctioning
4) CONDUCTED SUSCEPTIBILITY: 50 KHz ÷ 400 MHz (CS02):	no malfunctioning
5) CONDUCTED SUSCEPTIBILITY: SPIKES (CS06):	no malfunctioning
6) RADIATED EMISSIONS: 14 KHz ÷ 15.5 GHz (RE02):	< limits with some *
7) RADIATED SUSCEPTIBILITY: MAGNETIC FIELD, SPIKES(RS02):	no malfunctioning
8) RADIATED SUSCEPTIBILITY: ELECTRIC FIELD (RS03):	no malfunctioning

* out of limits points

In the following document each test is presented with a brief description of the operative conditions, the used instrumentation and the obtained results.
A photographic documentation is presented as well.

2 TEST DESCRIPTION

2.1 CONDUCTED EMISSIONS, DC POWER LEADS, 30 HZ ÷ 15 KHZ

Reference document: SSP30237C CE01

Objective: the aim of the test is to verify that the conducted emissions from EUT in the frequency band between 30Hz and 15kHz are within the limit requirements of the reference document.

Procedure: the test was carried out following the reference document guidelines. The conducted emissions of the EUT in the frequency band between 30Hz and 15kHz have been measured on all the DC power leads: +5V, +12V, -12V and power return.
During the test the EUT was held ON like in its normal operative conditions.

Equipment:

Type	Model	S/N	Calibration Expir. date
Lisn	UNIPG LISN50A	001	m.p.
Current sound	Solar 6741-1	882720	m.p.
Current sound	Hameg HZ56	P98-04-6347	m.p.
Oscilloscope	Tektronics TDS 210	B023805	17th January 2006
Receiver	Shaffner SCR 3101	143	27th July 2006
Data acquisition	Personal computer	-	n.a.

(m.p. = programmed maintenance - n.a. = not applicable)

Risults: the conducted emissions of the EUT in the frequency band between 30Hz and 15kHz measured on the DC power leads and return are normally within the limit requirements, with the exception of some frequency points which overstep the limits of the SSP30237C document.

The test result is reported in Appendix 1, § 3.1.
The test photographic documentation can be found in Appendix 2, § 4.1.

2.2 CONDUCTED EMISSIONS, DC POWER LEADS 15 KHZ ÷ 50 MHZ

Reference document: SSP30237C CE03

Objective: the aim of the test is to verify that the conducted emissions from EUT in the frequency band between 15KHz and 50MHz are within the limit requirements of the reference document.

Procedure: the test was carried out following the reference document guidelines. The conducted emissions of the EUT in the frequency band between 15KHz and 50MHz have been measured on all the DC power leads: +5V, +12V, -12V and power return. During the test the EUT was held ON like in its normal operative conditions.

Equipment:

Type	Model	S/N	Calibration Expir. date
Lisn	UNIPG LISN50A	001	m.p.
Current sound	Solar 6741-1	882720	m.p.
Receiver	Shaffner SCR 3101	143	2th July 2006
Spectrum Analyzer	Agilent E4407B	MY41441068	24th August 2006
Data acquisition	Personal computer	-	n.a.

(m.p. = programmed maintenance - n.a. = not applicable)

Risults: the conducted emissions of the EUT in the frequency band between 15KHz and 50MHz measured on the DC power leads and return are normally within the limit requirements, with the exception of some frequency points which overstep the limits of the SSP30237C document.

The test result is reported in Appendix 1, § 3.2.
The test photographic documentation can be found in Appendix 2, § 4.1.

2.3 CONDUCTED SUSCEPTIBILITY, DC POWER LEADS, 30 HZ ÷ 50 KHZ

Reference document: SSP30237C CS01

Objective: the aim of the test is to verify the susceptibility of the EUT to conducted sinusoidal interference signals in the frequency band between 30Hz and 50KHz with level assigned by the reference document. During the test the EUT shall not exhibit any malfunction or degradation of performance.

Procedure: the test was carried out following the reference document guidelines. The conducted interference signal was injected on all the DC power leads: +5V, +12V, -12V and power return. The signal level was monitored with with the aid of an oscilloscope. During the test the EUT was held ON like in its normal operative conditions and remotely controlled for its possible malfunction or performance degradation.

Equipment:

Type	**Model**	**S/N**	**Calibration Expir. date**
Lisn	UNIPG LISN50A	001	m.p.
Oscilloscope	Tektronics TDS 210	B023805	17the January 2006
Signal generator	Hameg HM8130	130981P - 03074	28th January 2006
Audio Amplifier	FBT HP2100	FBR 063 O	23th August 2006
Trasformer	EuroTrafo TF-0K25-03	-	n.a.

(m.p. = programmed maintenance - n.a. = not applicable)

Risults: during the test and at the end of it the the EUT did not exhibit any malfunction or performance degradation.

The test photographic documentation can be found in Appendix 2, § 4.2.

2.4 CONDUCTED SUSCEPTIBILITY, AC POWER LEADS, 50 KHZ ÷ 400 MHZ

Reference document: SSP30237C CS02

Objective: the aim of the test is to verify the susceptibility of the EUT to conducted sinusoidal interference signals in the frequency band between 50KHz and 400MHz with level assigned by the reference document. During the test the EUT shall not exhibit any malfunction or degradation of performance.

Procedure: the test was carried out following the reference document guidelines. The conducted interference signal was injected on all the DC power leads: +5V, +12V, -12V with the exception of the power return. The signal level was monitored with the aid of an oscilloscope.
During the test the EUT was held ON like in its normal operative conditions and remotely controlled for its possible malfunction or performance degradation.

Equipment:

Type	Model	S/N	Calibration Expir. date
Lisn	Electro-metrics	EM-7820	m.p.
Oscilloscope	LeCroy 9314A	3467	15th March 2007
Signal generator	Rode & Schwartz SMY1	833104/011	10th December 2005
Amplifier	AR 25A250A	307913	24th December 2005
Amplifier	Schaffner	CBA9413A	12th December 2005

(m.p. = programmed maintenance - n.a. = not applicable)

Risults: during the test and at the end of it the the EUT did not exhibit any malfunction or performance degradation.

The test photographic documentation can be found in Appendix 2, § 4.2.

2.5 CONDUCTED SUSCEPTIBILITY, DC POWER LEADS, SPIKES

Reference document: SSP30237C CS06

Objective: the aim of the test is to verify the susceptibility of the EUT to a conducted interference signal following the indications contained in the reference document. During the test the EUT shall not exhibit any malfunction or degradation of performance.

Procedure: the test was carried out following the reference document guidelines. The conducted interference signal was injected on all the DC power leads: +5V, +12V, -12V and power return. The signal level was monitored with the aid of an oscilloscope.
During the test the EUT was held ON like in its normal operative conditions and remotely controlled to check for its possible malfunction or performance degradation.

Equipment:

Type	**Model**	**S/N**	**Calibration Expir. date**
Lisn	UNIPG LISN50A	001	m.p.
Signal generator	Hameg HM8130	130981P - 03074	28th January 2006
Spike generator	Spikes 1	007	18th March 2007
Spike generator	UNIPG Spike 2	008	18th March 2007
Oscilloscope	Tektronics TDS 210	B023805	17th January 2006

(m.p. = programmed maintenance - n.a. = not applicable)

Risults: during the test and at the end of it the the EUT did not exhibit any malfunction or performance degradation.

The test photographic documentation can be found in Appendix 2, § 4.2.

2.6 RADIATED EMISSIONS, ELECTRIC FIELD, 14 KHZ ÷ 15,5 GHZ

Reference document: SSP30237C RE02

Objective: the aim of the test is to verify that the electric field radiated emissions from EUT in the frequency band between 14KHz and 15.5GHz fall within the limit requirements of the reference document.

Procedure: the test was carried out following the reference document guidelines. The the narrow band electric field radiated emissions from EUT in the frequency band between 14KHz and 15.5GHz were measured by a receiving antenna located at the distance of 1 meter from the EUT. The EUT and receiving antenna were all contained inside an semi-anechoic shielded chamber.
During the test the EUT was held ON like in its normal operative conditions.

Equipment:

Type	Model	S/N	Calibration Expir. date
Lisn	UNIPG LISN50A	001	m.p.
Receiver	Shaffner SCR 3101	143	27th July 2006
Spectrum Analyzer	Agilent E4407B	MY41441068	24th Augost 2006
Active rod antenna	A.H. System SAS-550-1B	313	12th April 2006
Bilog Antenna	Shaffner CBL6111C	2602	m.p.
Horn Antenna	A.H. Systems SAS-571	539	m.p.
Data Acquisition	Personal computer	-	n.a.

(m.p. = programmed maintenance - n.a. = not applicable)

Risults: the narrow band electric field radiated emissions from EUT in the frequency band between 14KHz and 15.5GHz are normally within the limit requirements, with the exception of some frequency points which overstep the limits of the SSP30237C document.

The test result is reported in Appendix 1, § 3.3.
The test photographic documentation can be found in Appendix 2, § 4.3.

2.7 RADIATED SUSCEPTIBILITY, MAGNETIC INDUCTION FIELD, SPIKES

Reference document: SSP30237C RS02

Objective: the aim of the test is to verify the EUT susceptibility to a magnetic radiated pulse applied with the procedure described in the reference document. During the test the EUT shall not exhibit any malfunction or degradation of performance.

Procedure: the test was carried out following the reference document guidelines. The magnetic pulse was injected into the DC power supply cables of the EUT through a coil surroundig the cables.
During the test the EUT was held ON like in its normal operative conditions and remotely controlled to check for its possible malfunction or performance degradation.

Equipment:

Type	Model	S/N	Calibration Expir. date
Lisn	UNIPG LISN50A	001	m.p.
Signal generator	Hameg HM8130	130981P - 03074	28th January 2006
Spike generator	Spikes 1	007	18th March 2007
Spike generator	UNIPG Spike 2	008	18th March 2007
Oscilloscope	Tektronics TDS 210	B023805	17th January 2006

(m.p. = programmed maintenance - n.a. = not applicable)

Risults: during the test and at the end of it the the EUT did not exhibit any malfunction or performance degradation.

The test photographic documentation can be found in Appendix 2, § 4.4.

2.8 RADIATED SUSCEPTIBILITY, ELECTRIC FIELD, 14 KHZ ÷ 18 GHZ

Reference document: SSP30237C RS03

Objective: the aim of the test is to verify the EUT susceptibility to an electric radiated signal applied with the procedure described in the reference document in the frequency band between 14KHz and 18GHz. During the test the EUT shall not exhibit any malfunction or degradation of performance.

Procedure: the test was carried out following the reference document guidelines. The disturbance was injected into the EUT through an antenna located ad a distance of 1 meter from it. The radiated electric field level was monitored with an electric field sound.
During the test the EUT was held ON like in its normal operative conditions and remotely controlled to check for its possible malfunction or performance degradation.

Equipment:

Type	Model	S/N	Calibration Expir.date
Lisn	UNIPG LISN50A	001	m.p.
Signal Generator	Rode & Schwartz SMY1	833104/011	10th December 2005
Signal Generator	HP 8673C	2645A00405	9th May 2006
Amplificatore	AR 25A250A	307913	24th December 2005
Amplifier	Schaffner CBA9413A	9908	12th December 2005
Amplifier	Huges 1177-H01	185	9th May 2006
Amplifier	Huges 1177-H02	248	9th May 2006
Amplifier	Huges 1277-H09	129	9th May 2006
Amplifier	Varian V7U6991K1D	6208	25th May 2006
Electric field sound	PMM EHP50	0110J00106	28th January 2006
Electric field sound	PMM EP 105	0010J21004	26th November 2006
Electric field sound	PMM EP 183	J20705	26th November 2006
Rod Antenna	A. H. System SAS-551	202	m.p.
Bilog Antenna	Shaffner CBL 6141A	4170	m.p.
Horn Antenna	A.H. Systems SAS-571	539	m.p.

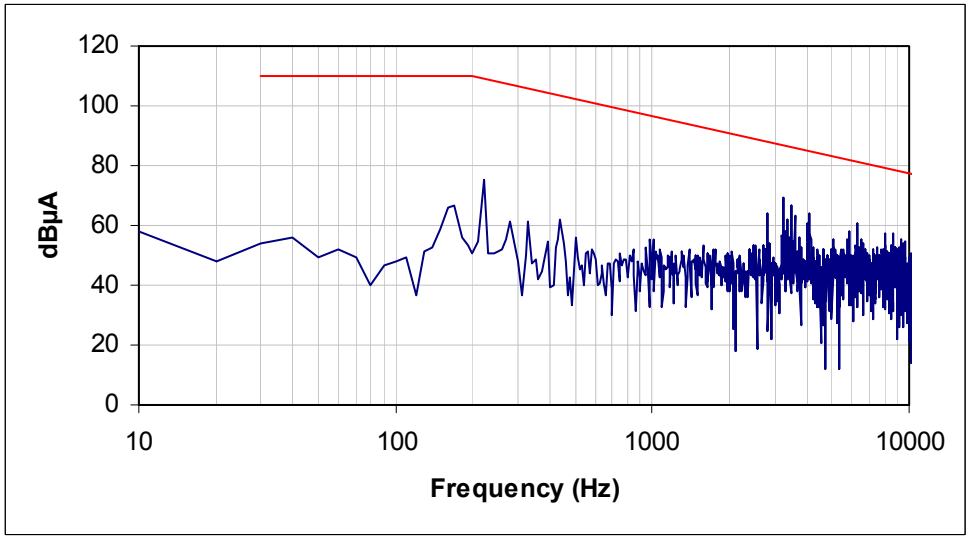
(m.p. = programmed maintenance - n.a. = not applicable)

Risults: during the test and at the end of it the the EUT did not exhibit any malfunction or performance degradation.

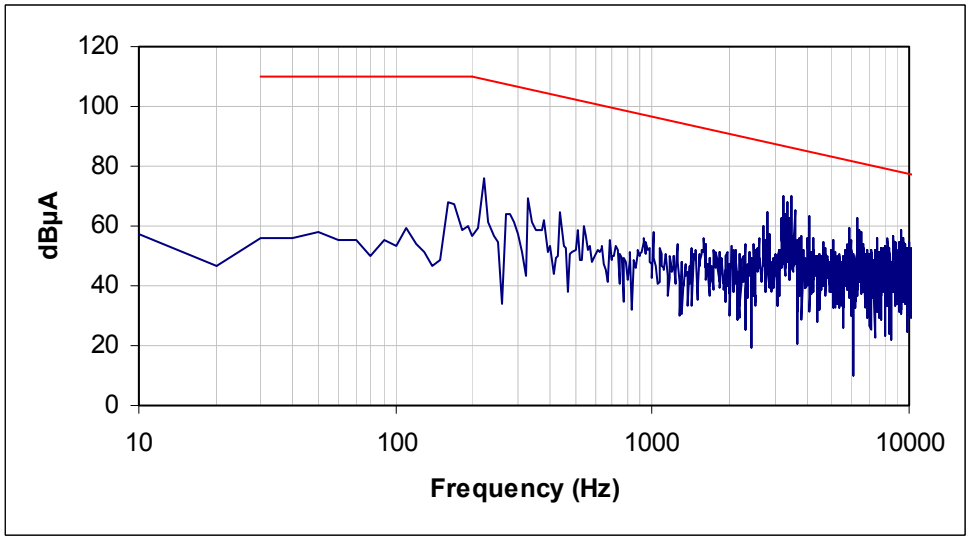
The test photographic documentation can be found Appendix 2, § 4.4.

3 APPENDIX 1 : TEST RESULTS

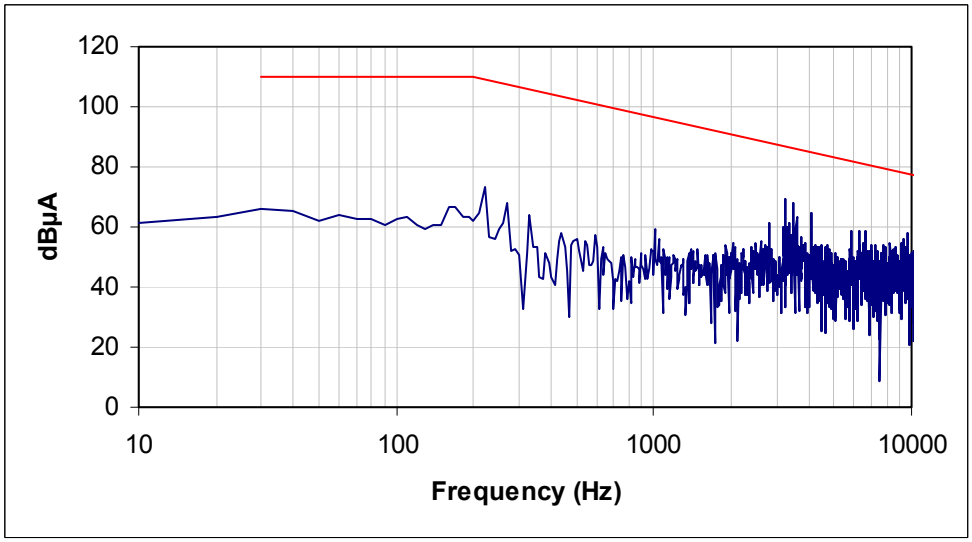
3.1 TESTS CE01



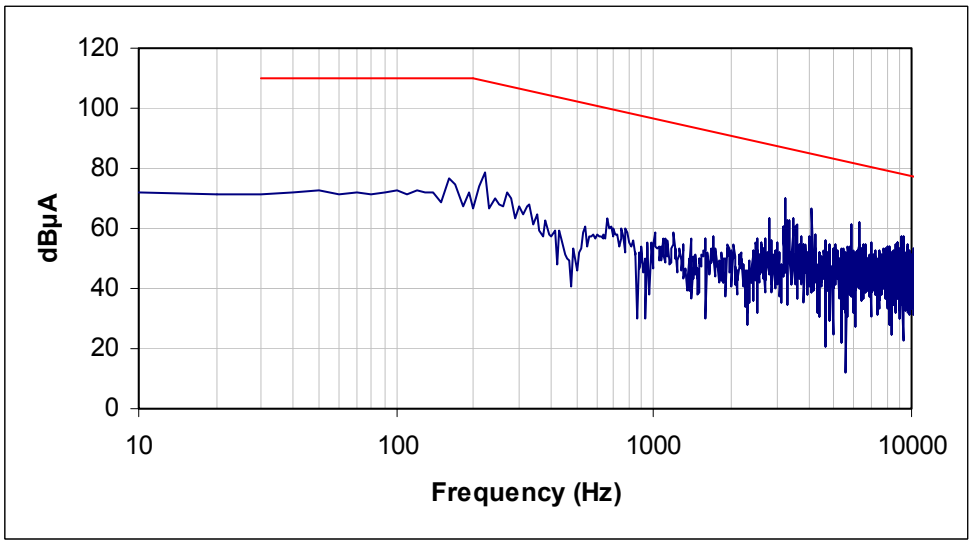
Test CE01, part 1, -12V



Test CE01, part 1, +5V



Test CE01, part 1, GND



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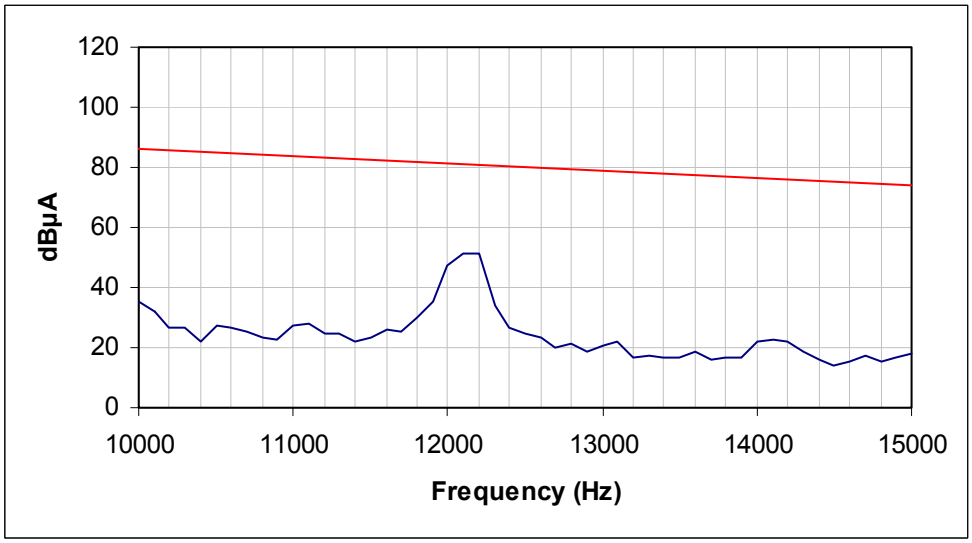
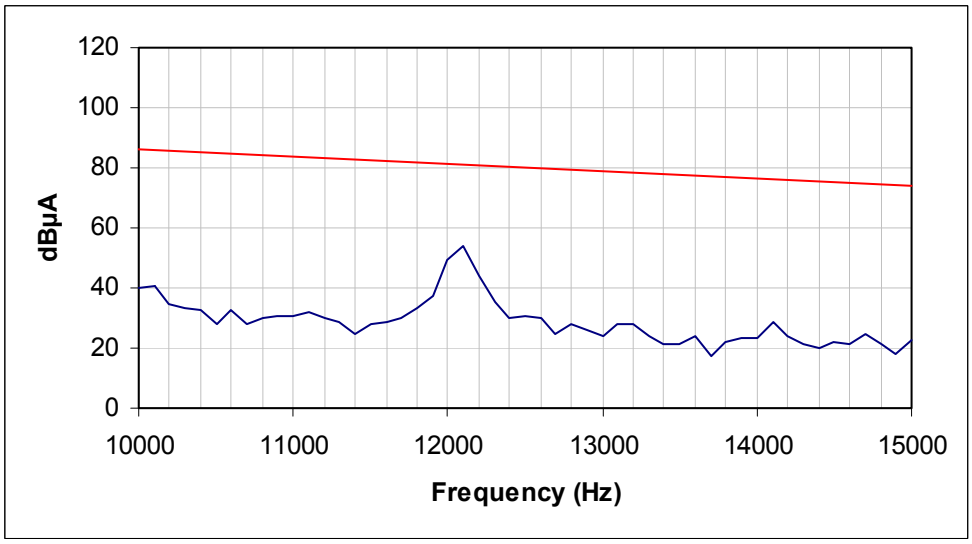
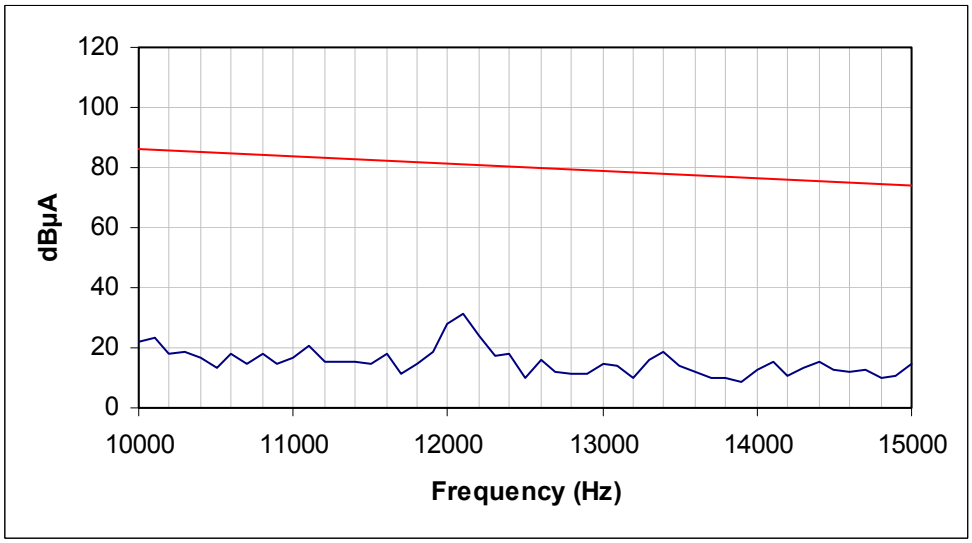


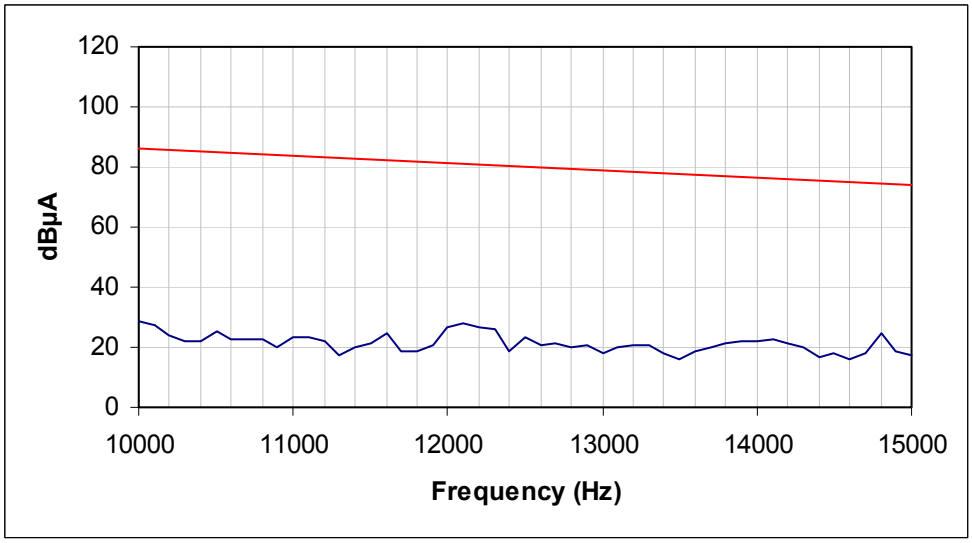
Test CE01, part 2, -12V



Test CE01, part 2, +5V

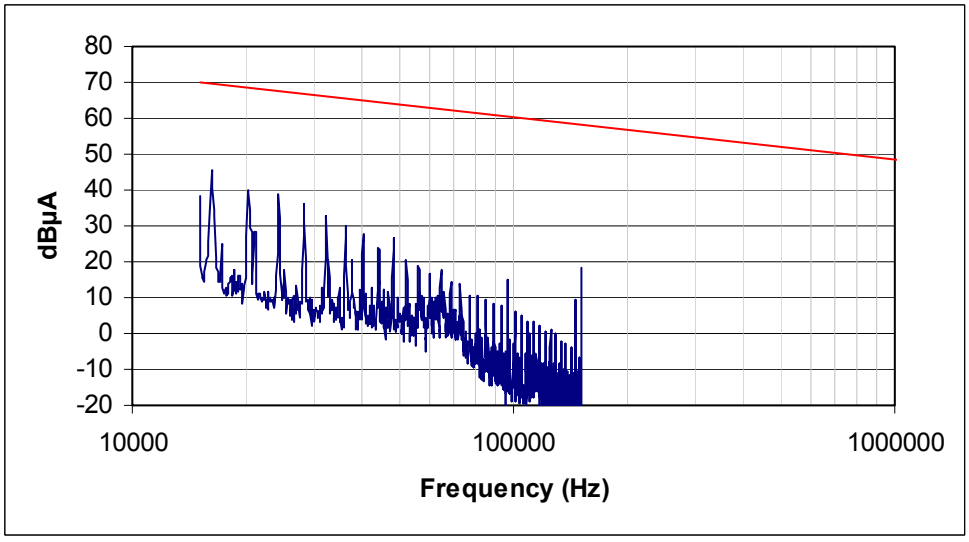


Test CE01, part 2, GND



Test CE01, part 2, +12V

3.2 TESTS CE03



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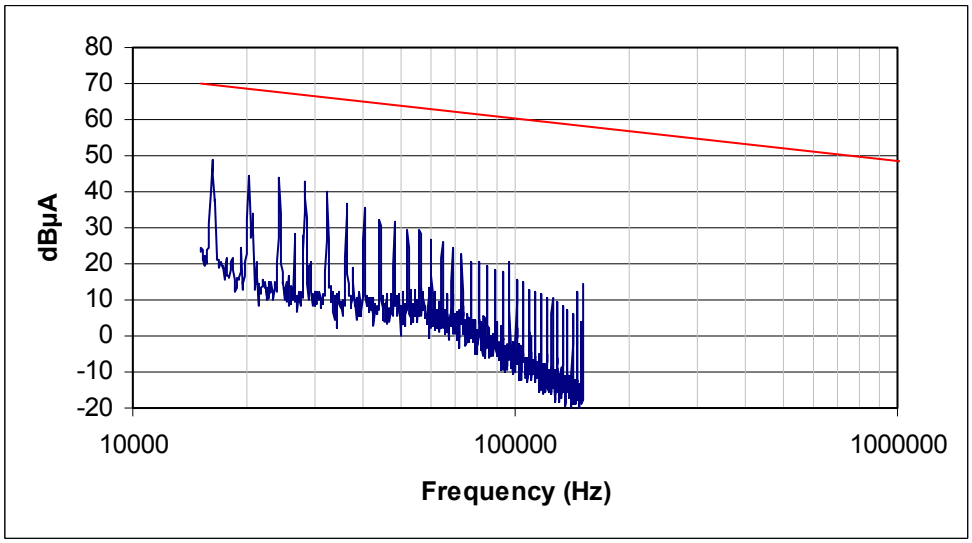

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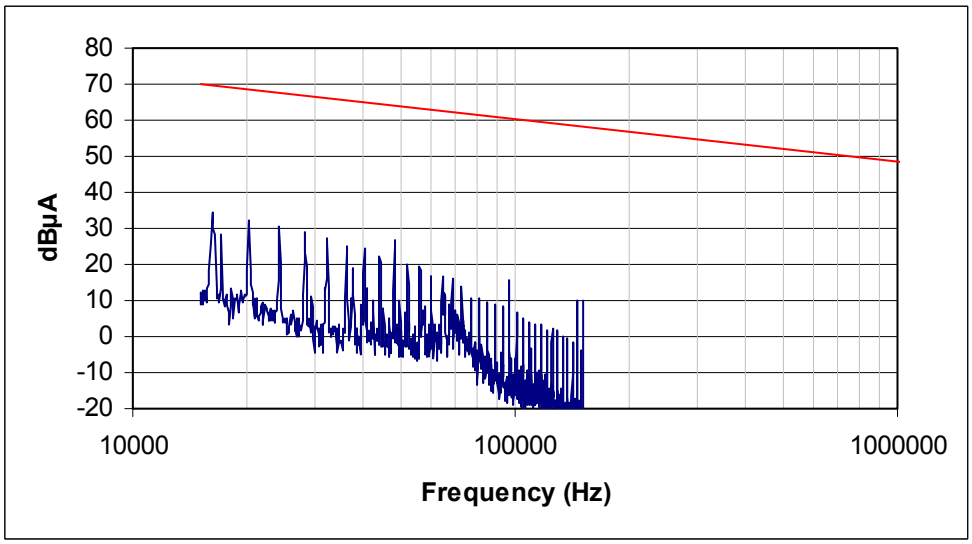

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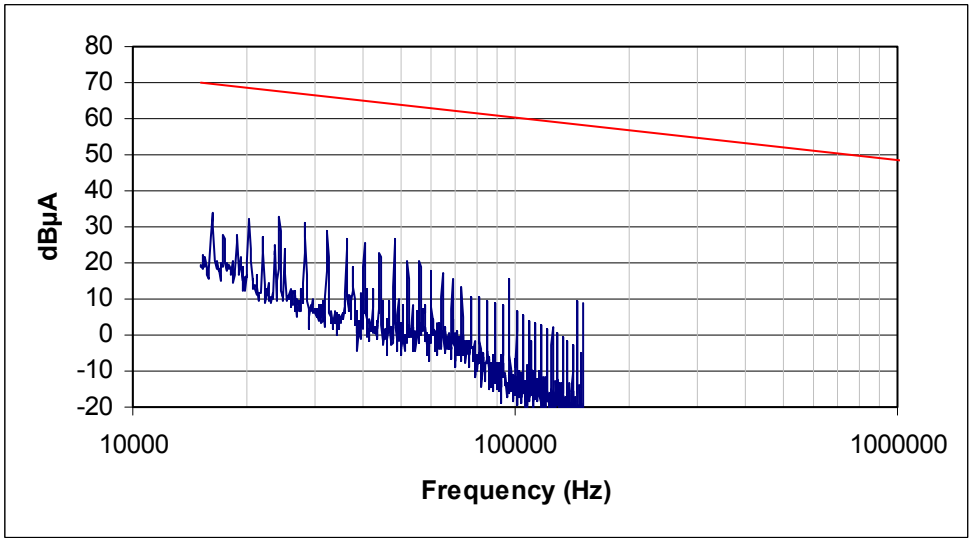

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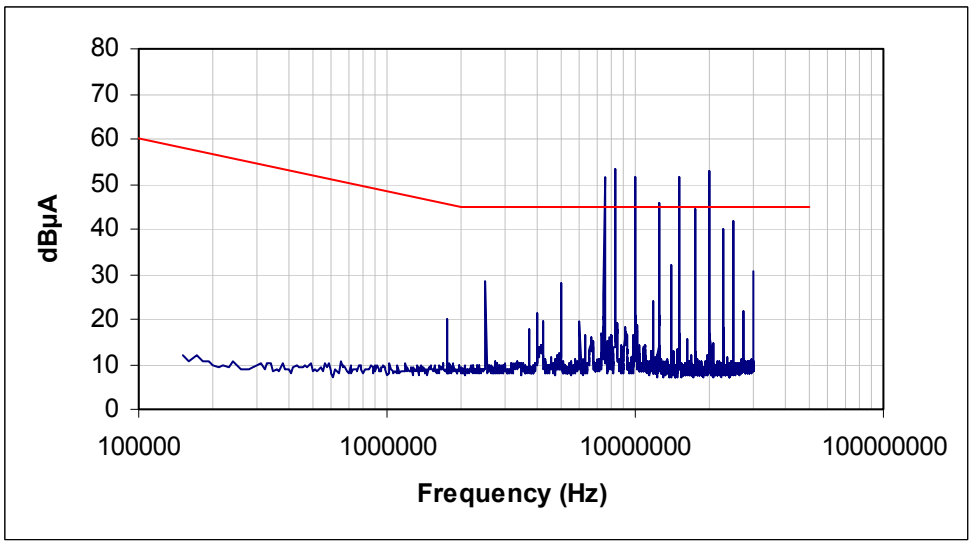

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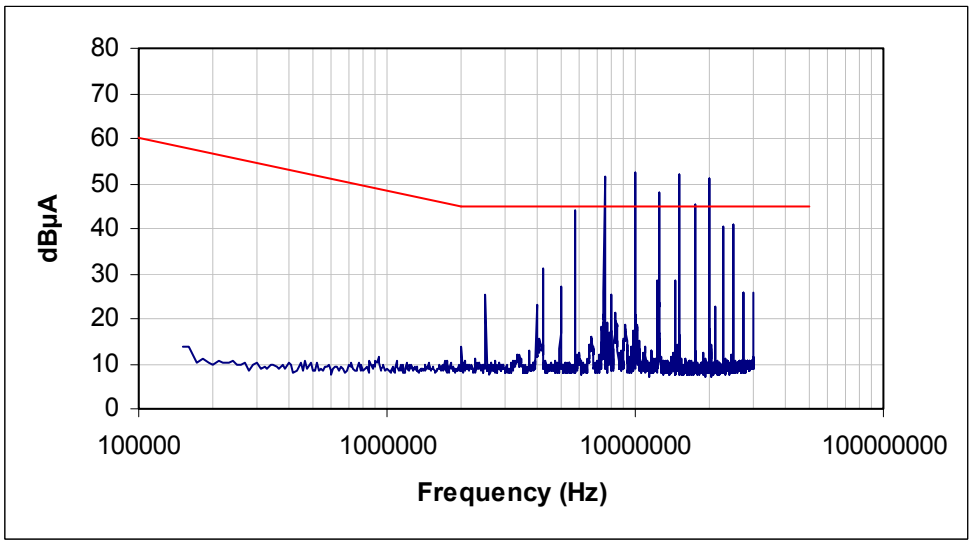

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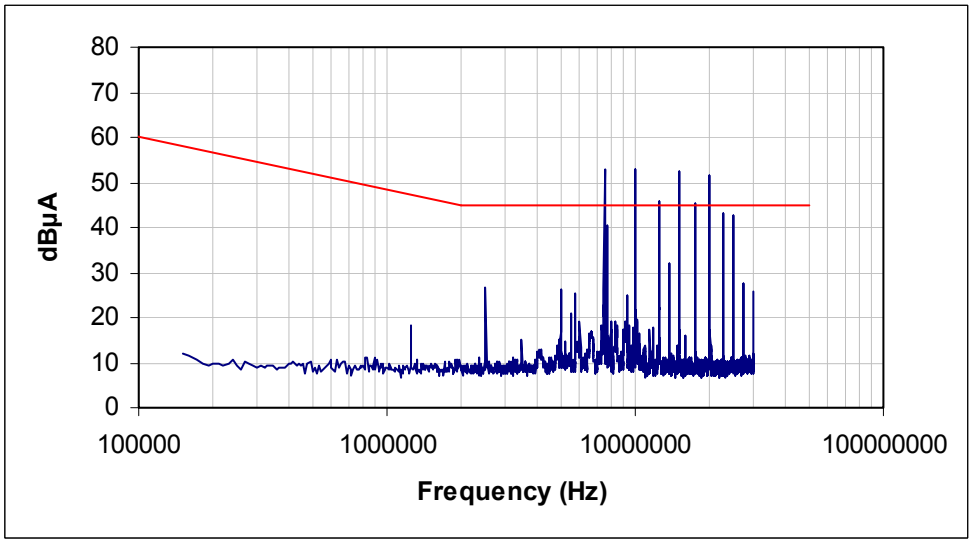

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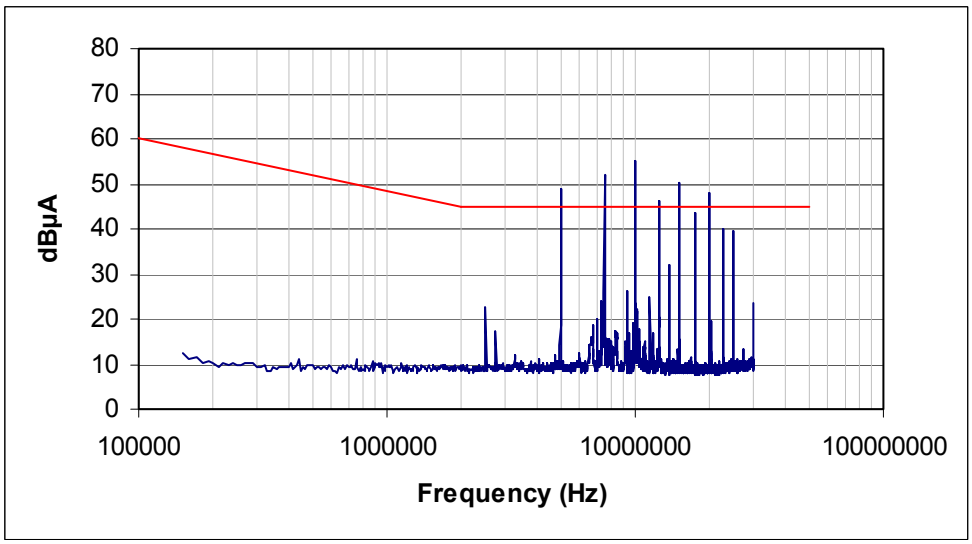
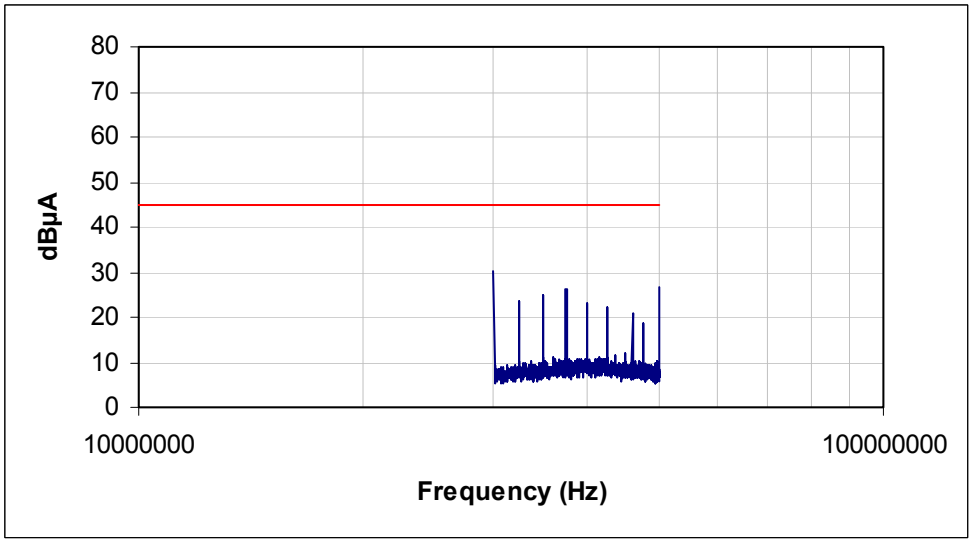
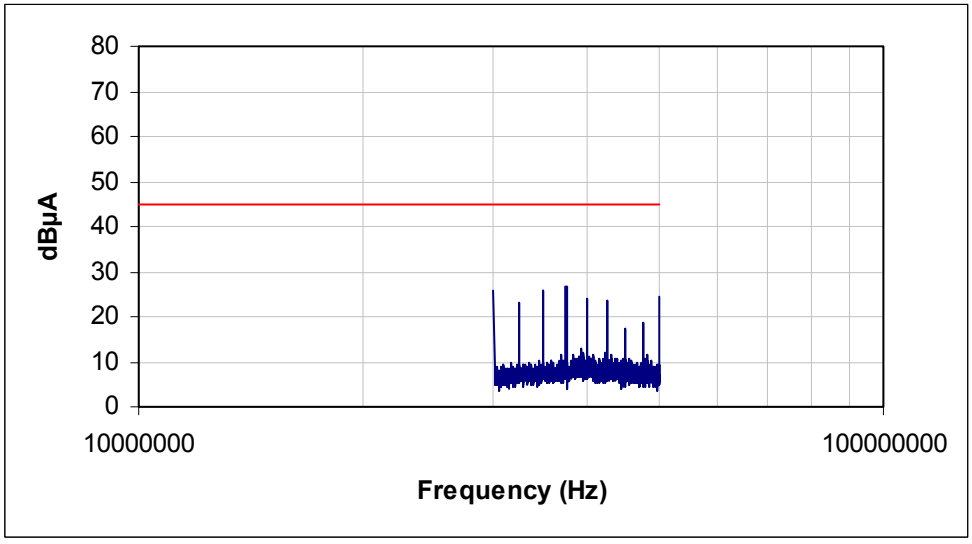


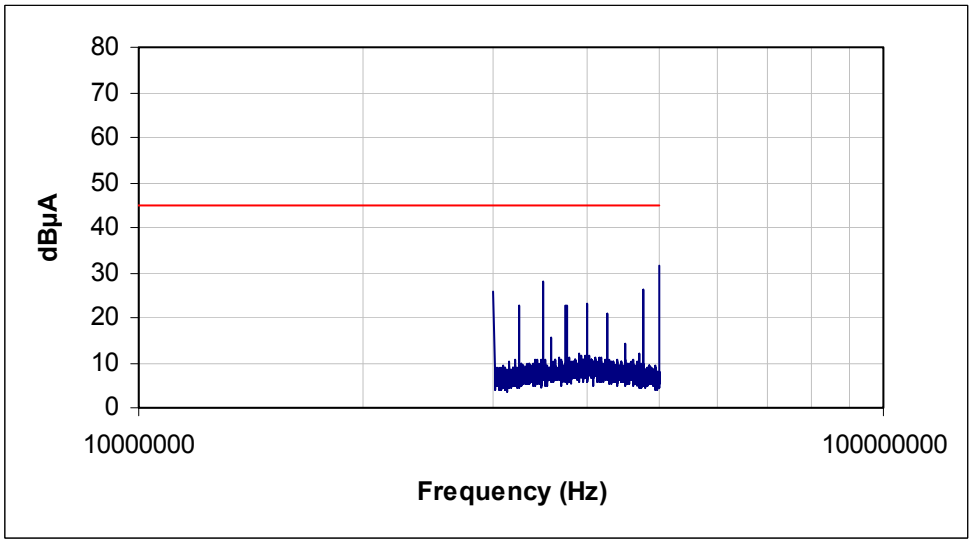
Test CE03, part2, +12V



Test CE03, part3, -12V



Test CE03, part3, +5V



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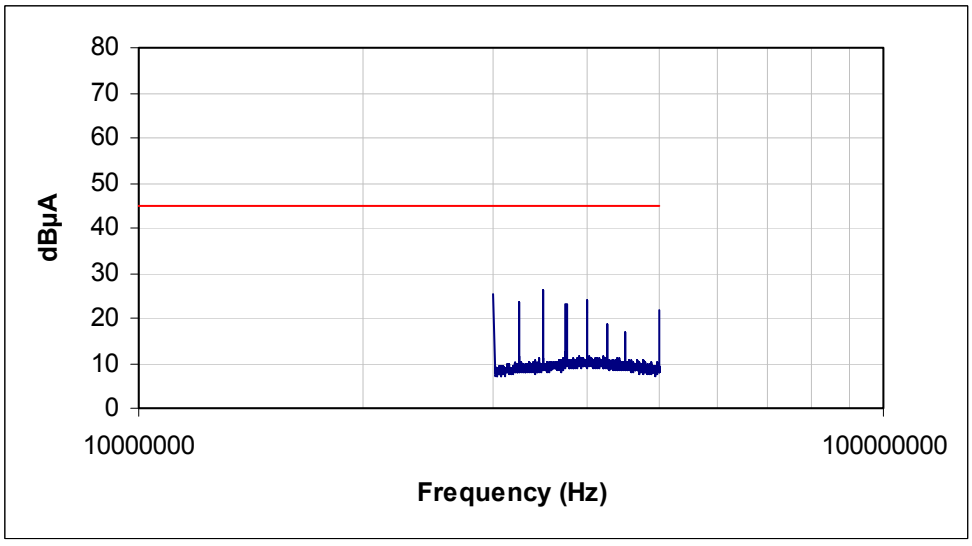
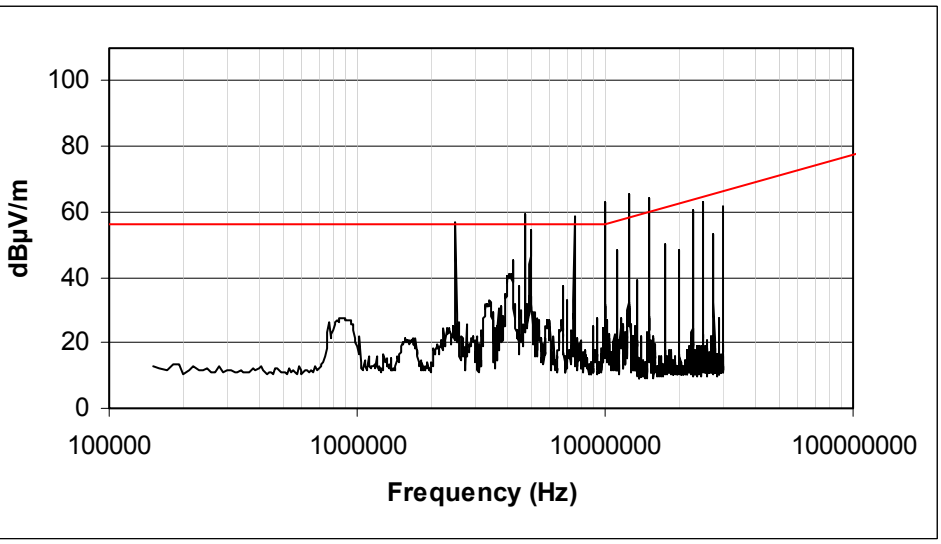
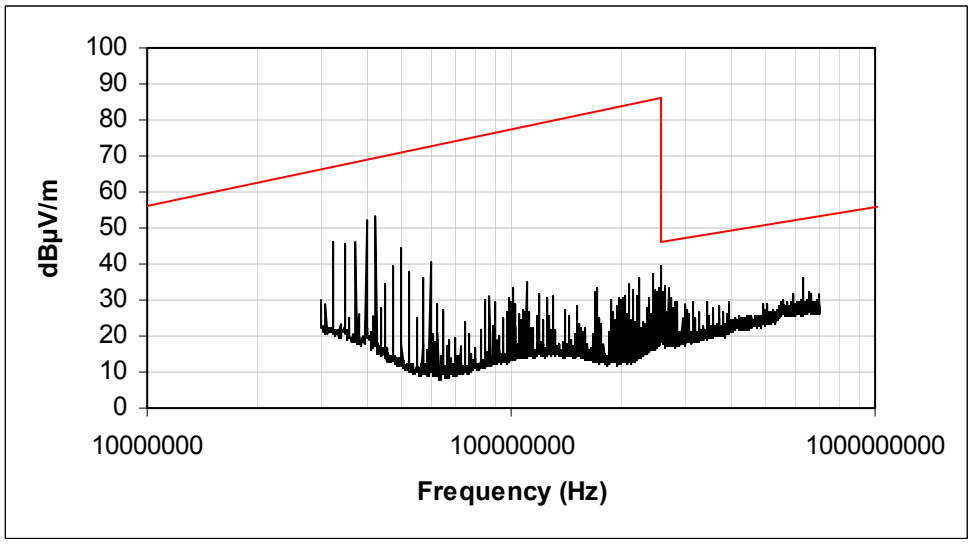


Test CE03, part3, +12V

3.3 TESTS RE02



Test RE02, part 1



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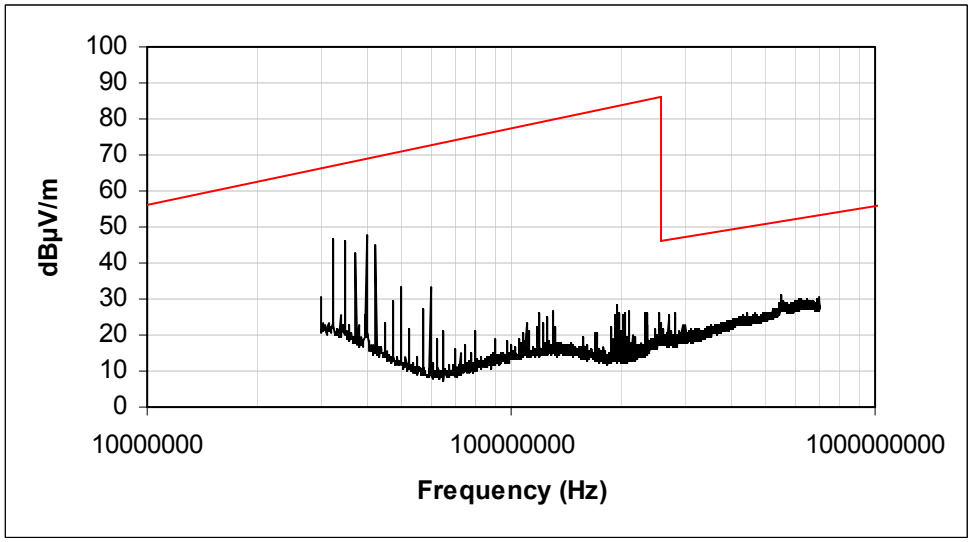

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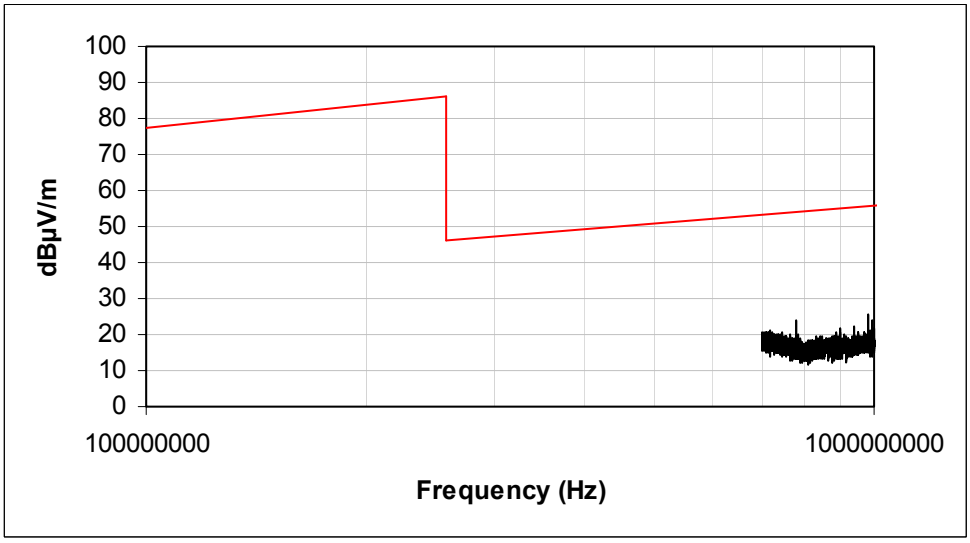

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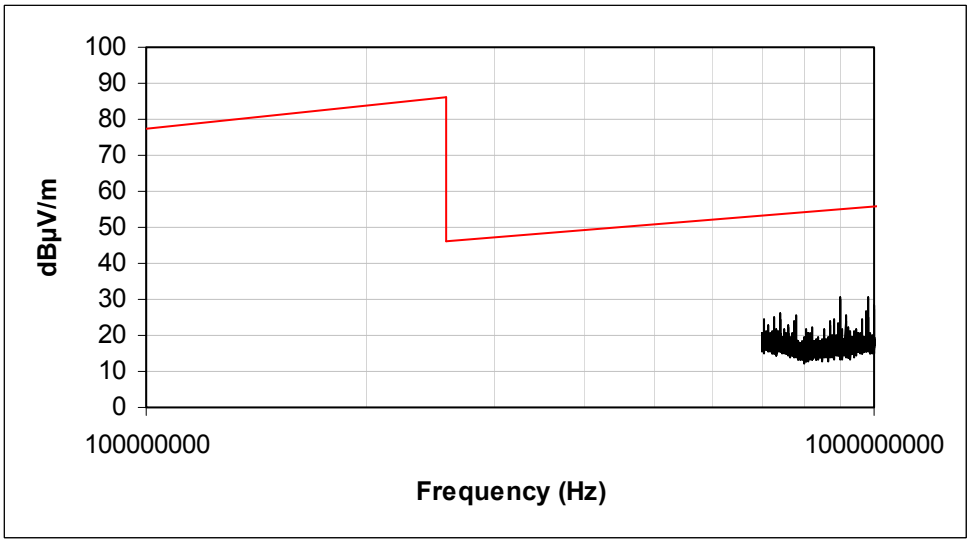

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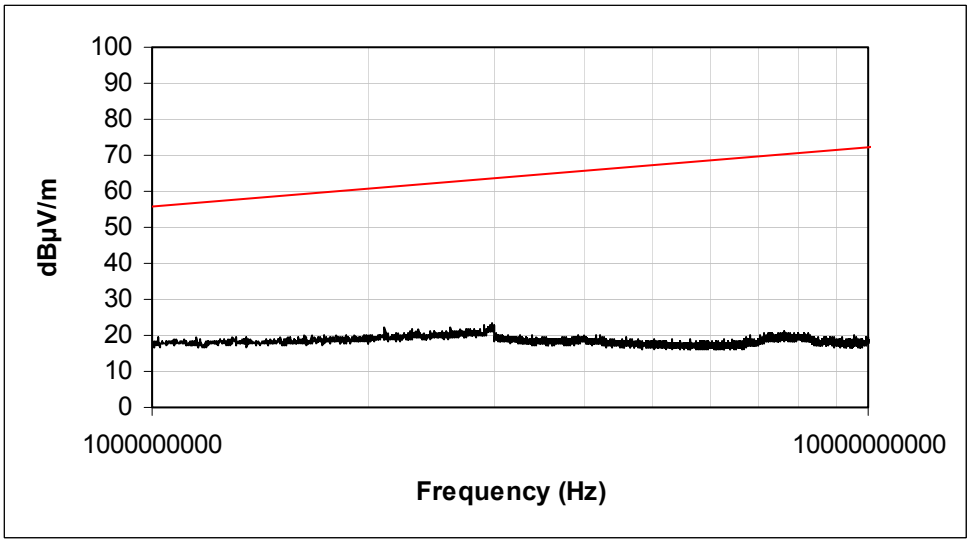

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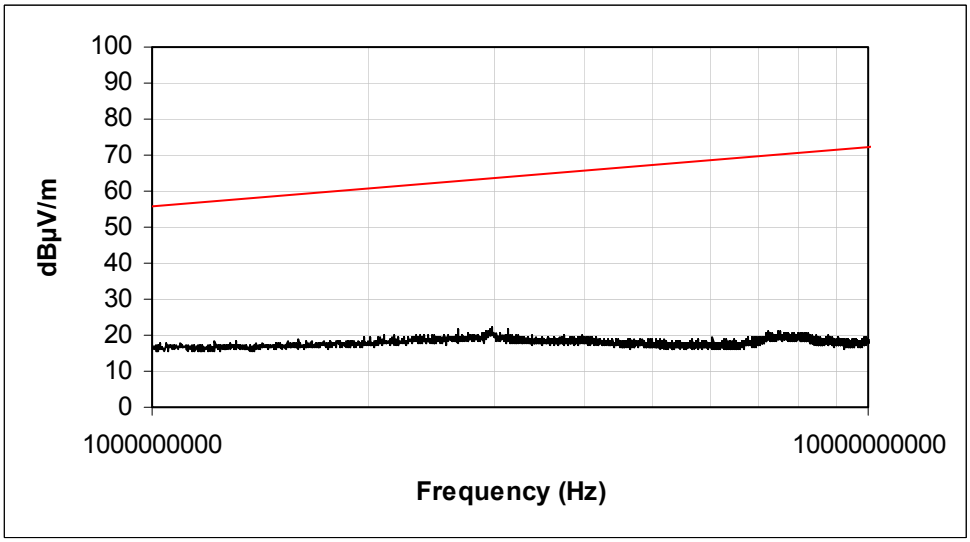
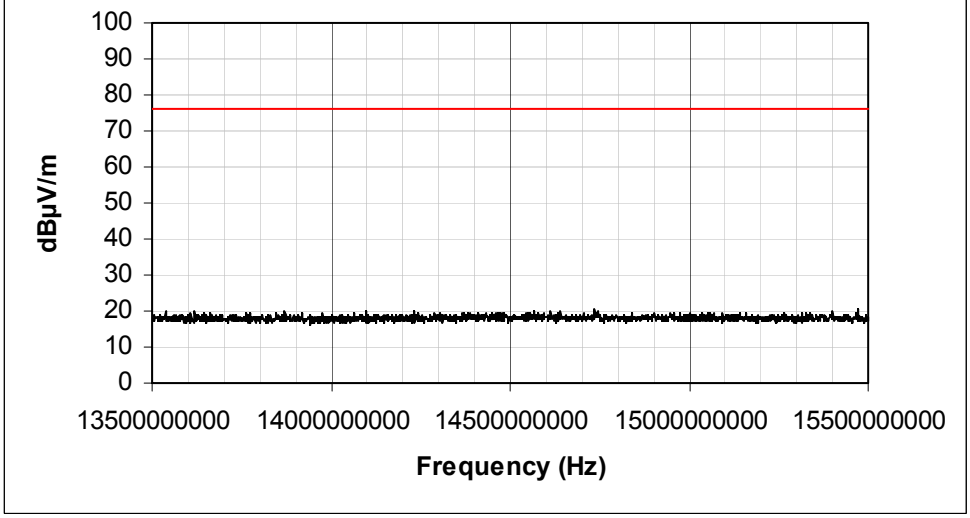
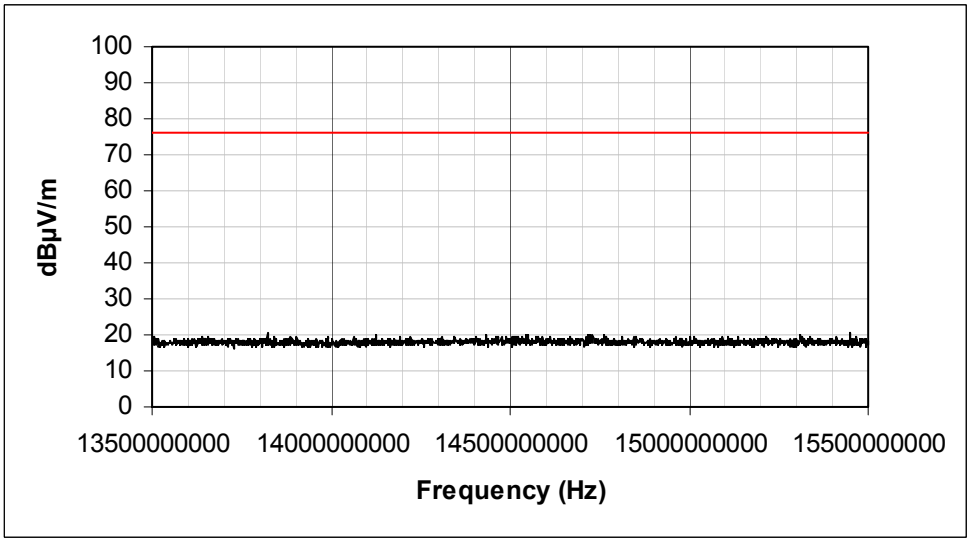


Test RE02, part 4, Horizontal Pol.



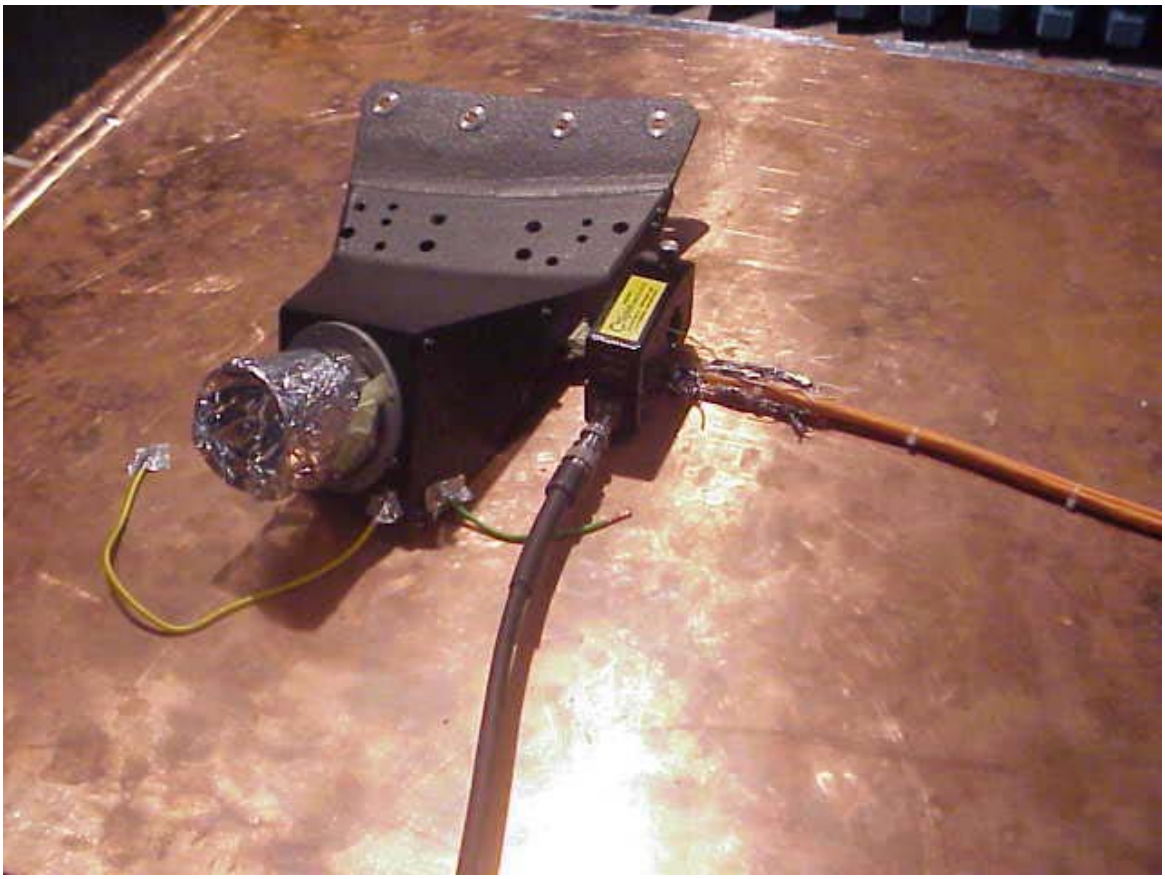
Test RE02, part 5, Vertical Pol.



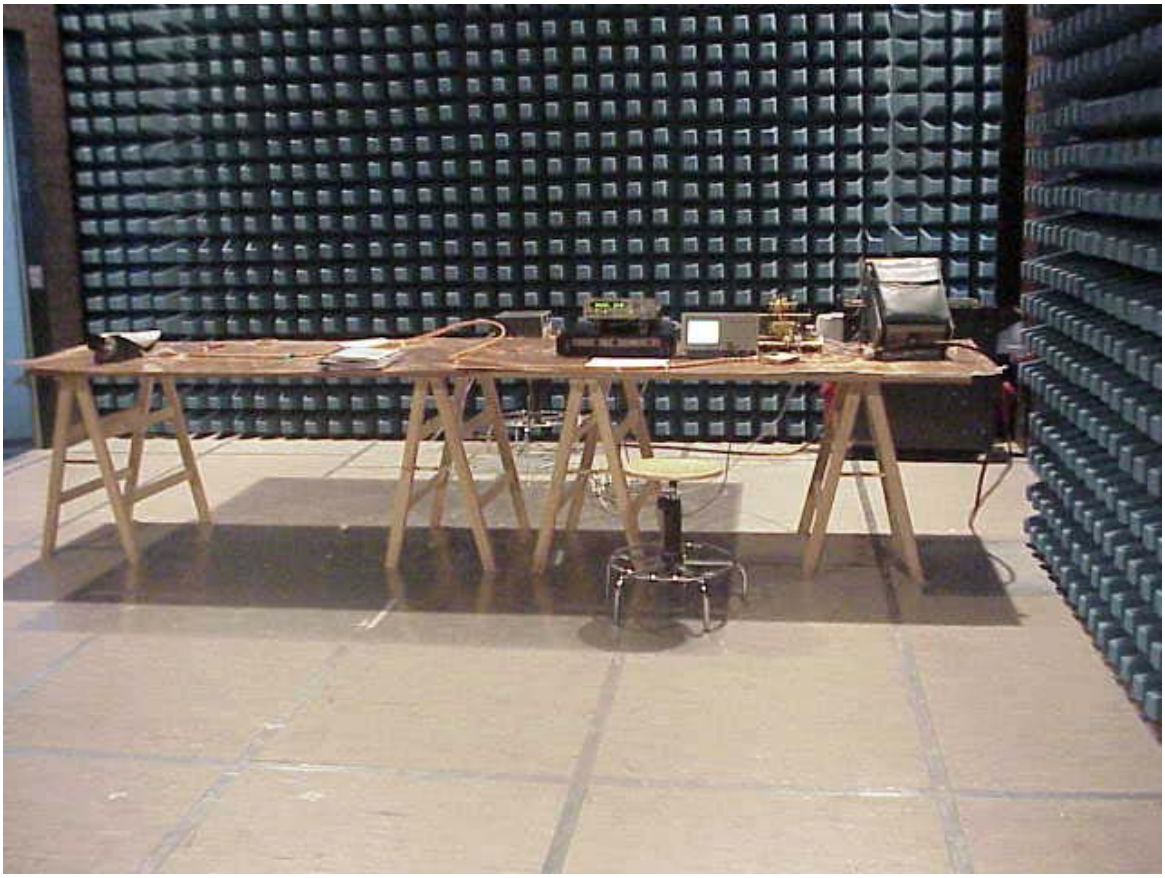
Test RE02, part 5, Horizontal Pol.

4 APPENDIX 2 : PHOTOGRAPHIC DOCUMENTATION

4.1 CONDUCTED EMISSIONS DC AND AC POWER LEADS (CE)



4.2 CONDUCTED SUSCETTIBILITY DC AND AC POWER LEADS (CS)



4.3 RADIATED EMISSION ELECTRIC FIELD (RE)

4.4 RADIATED SUSCETTIBILITY ELECTRIC FIELD (RS)